

What is claimed is:

1. A method for reducing waste accumulation comprising using an environmentally degradable disposable material, wherein said material comprises a hydroxycarboxylic acid-containing polymer and wherein said  
5 material degrades hydrolytically during storage, use and disposal stages in a controlled manner such that the disposal degradation rate of said material is accelerated relative to the average of the storage and use degradation rates of said material.

2. The method of Claim 1, wherein said waste is selected from the group consisting of landfill waste, water waste, and landscape surface waste.

3. The method of Claim 1, wherein said degradation rates comprise changes in the molecular weight of said disposable material over time.

4. The method of Claim 3, wherein said average of said storage and said use degradation rates is less than about 50 percent of said disposal degradation rate.

5. The method of Claim 3, wherein said average of said storage and said use degradation rates is less than about 33 percent of said disposal degradation rate.

6. The method of Claim 3, wherein said average of said storage and said use degradation rates is less than about 10 percent of said disposal degradation rate.

7. The method of Claim 3, wherein said average of said storage and said use degradation rates is less than about 5 percent of said disposal degradation rate.

8. The method of Claim 1, wherein said disposable material is capable of being about 100 percent hydrolytically degraded after discard.

9. The method of Claim 1, wherein said disposable material is at least about 98 percent hydrolytically degraded within about ten years after discard.

10. The method of Claim 1, wherein said disposable material is at least about 98 percent hydrolytically degraded within about five years after discard.

11. The method of Claim 1, wherein said disposable material is at least about 98 percent hydrolytically degraded within about three years after discard.

12. The method of Claim 1, wherein said disposable material is hydrolytically degraded to monomers and oligomers essentially about or less than about 600 daltons molecular weight.

13. The method of Claim 1, wherein said disposable material is further capable of being degraded by biological degradation.

14. The method of Claim 1, wherein said disposable material is further capable of being degraded by microbial degradation.

15. The method of Claim 1, wherein said disposable material is further capable of being biologically degraded to essentially carbon dioxide and water.

16. The method of Claim 1, wherein said disposable material is further capable of being biologically degraded to essentially carbon dioxide and methane.

17. The method of Claim 1, wherein said disposable material is selected from the group consisting of films, foams, coatings, molded articles, extruded articles, nonwoven fibers, pellets, powders, laminates, and adhesives.

18. The method of Claim 1, wherein said disposable material is selected from the group consisting of films, foams, coatings, and molded articles.

19. The method of Claim 1, wherein said disposable material comprises a packaging material.

20. The method of Claim 1, wherein said controlled manner of hydrolytic degradation is achieved by adding at least one activator compound to said disposable material, wherein said activator compound accelerates degradation of said disposable material.

21. The method of Claim 20, wherein said activator compound is selected from the group consisting of an acidic compound, a basic compound that generates hydroxyl ions when exposed to water, a moisture-containing compound, and water.

22. The method of Claim 20, wherein said activator compound is selected from the group consisting of fumaric acid, succinic acid, tartaric acid, malic acid, adipic acid, citric acid, glutamic acid, methane sulfonic acid, phosphoric acid, polyphosphoric acid, lactic acid oligomers, water, and mixtures thereof.

23. The method of Claim 20, wherein said activator compound is selected from the group consisting of sodium bicarbonate, sodium carbonate, potassium bicarbonate,

potassium carbonate, calcium hydroxide, ammonium borate,  
5 and mixtures thereof.

24. The method of Claim 20, wherein said activator compound is selected from the group consisting of water, starch-based hydrophilic polymers, cellulose-based hydrophilic polymers, hydrates of inorganic acids or salts  
5 thereof, hydrates of organic acids or salts thereof, and mixtures thereof.

25. The method of Claim 20, wherein said activator compound is blended with said material.

26. The method of Claim 20, wherein said material is coated or laminated with said activator compound.

27. The method of Claim 20, wherein said activator compound is microencapsulated.

28. The method of Claim 20, wherein said activator compound is microencapsulated in a capsule comprising a capsule formulation selected from the group consisting of polylactides, polylactic acids, amyloses, ethyl cellulose, polyethylene terephthalate, aliphatic polyesters, and  
5 cellulose acetate butyrate.

29. The method of Claim 27, wherein said activator compound is released from microencapsulation upon exposure to pressure, abrasion, heat, moisture or acid.

30. The method of Claim 1, wherein said controlled manner of hydrolytic degradation is achieved by adding at least one blotting compound to said disposable material, wherein said blotting compound absorbs moisture or  
5 degradation products that promote degradation.

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31. The method of Claim 29, wherein said blotting compound is selected from the group consisting of water grabbers, at least one alkaline compound capable of neutralizing acid, dry mineral fillers, and mixtures thereof.

32. The method of Claim 29, wherein said blotting compound is microencapsulated in a capsule, wherein said capsule is susceptible to degradation by water or acid.

33. The method of Claim 1, wherein said controlled manner of hydrolytic degradation is achieved by coating said disposable material with at least one coating compound to form a coat around said disposable material.

34. The method of Claim 33, wherein said coat is prone to abrasion.

35. The method of Claim 33, wherein said coating compound is hydrophobic.

36. The method of Claim 33, wherein said coat has a contact angle of at least about 90 degrees.

37. The method of Claim 33, wherein said step of coating comprises laminating.

38. The method of Claim 1, wherein said controlled manner of hydrolytic degradation is achieved by producing a disposable material comprising at least one copolymer selected from the group consisting of copolymers comprising a mixture of at least two polymers, copolymers comprising a mixture of monomers, copolymers comprising a mixture of polymer blocks, and copolymers comprising a mixture of monomers and polymer blocks.

39. The method of Claim 38, wherein said monomer is selected from the group consisting of hydroxycarboxylic acids and cyclic esters thereof, cyclic carbonates, dicarboxylic acids, anhydrides, diisocyanates, glycols, oligomeric polyalkylene adipates, and mixtures thereof.

40. The method of Claim 38, wherein said monomer is selected from the group consisting of cyclic esters of hydroxycarboxylic acids, dilactones, cyclic carbonates, and mixtures thereof.

41. The method of Claim 38, wherein said monomer is selected from the group consisting of L-lactide, D-lactide, D,L-lactide, glycolide, 2-methyl glycolide, tetramethyl glycolide, dioxanone, caprolactone, ethylene carbonate, propylene carbonate, and mixtures thereof.

42. The method of Claim 38, wherein said polymer block is selected from the group consisting of hydroxycarboxylic acid polymers, polymers of cyclic esters of hydroxycarboxylic acids, alkyl ester polymers, alkylene carbonate polymers, cyclic carbonate polymers, polyethylene glycols, polyethylene terephthalates, phthalate esters, polyethylenes, polystyrenes, polyvinyl chlorides, polypropylenes, and mixtures thereof.

43. The method of Claim 38, wherein said polymer block is selected from the group consisting of  $\alpha$ -hydroxycarboxylic acid polymers, polymers of cyclic esters of  $\alpha$ -hydroxycarboxylic acids, lactone polymers, dilactone polymers, and cyclic carbonate polymers, and mixtures thereof

44. The method of Claim 38, wherein said polymer block is selected from the group consisting of lactic acid polymers, glycolic acid polymers, L-lactide polymers, D-lactide polymers, D,L-lactide polymers, glycolide polymers, polyethylene terephthalates, adipic acid ethylene-glycol polymers, epsilon-caprolactone polymers, delta-valerolactone polymers, and mixtures thereof.

45. The method of Claim 38, wherein said copolymer comprising an interpenetrating network of at least two polymers.

46. The method of Claim 1, wherein said controlled manner of hydrolytic degradation is achieved by adding at least one plasticizer to said disposable material.

47. The method of Claim 46, wherein said plasticizer is selected from the group consisting of internal plasticizers and external plasticizers.

48. The method of Claim 46, wherein said plasticizer is selected from the group consisting of hydroxycarboxylic acids and cyclic esters thereof, oligomers of hydroxycarboxylic acids and cyclic esters thereof, dibasic acid esters, polyesters, aromatic ethers, aromatic esters, esters of relatively long chain acids, esters of relatively long chain alcohols, sulfonamides, tertiary amines, alkylene carbonates, keto-esters, ketones, compounds having multiple ketone groups, ethers, and mixtures thereof.

49. The method of Claim 46, wherein said plasticizer is selected from the group consisting of  $\alpha$ -hydroxy-

carboxylic acids and cyclic esters thereof, oligomers of  
 $\alpha$ -hydroxycarboxylic acids and cyclic esters thereof,  
5 lactones, dilactones, dibasic acid esters, low molecular  
weight polyesters, diphenyl ether, diethyl phthalate,  
ethyl octoate, lauryl acetate, polypropylene glycol  
adipate, glyceryl diacetate, glyceryl triacetate,  
cyclododecanone, isophorone, glucose ethers, sucrose  
10 ethers, polyethylene glycol ethers, polyethylene glycol  
esters, and mixtures thereof.

50. The method of Claim 46, wherein said plasticizer  
is selected from the group consisting of lactic acid, L-  
lactide, D-lactide, D,L-lactide, glycolide, glycolic acid  
oligomers, lactic acid oligomers, glycolide oligomers, L-  
5 lactide oligomers, D-lactide oligomers, D,L-lactide  
oligomers, butyl lactate, ethyl lactate, diethyl adipate,  
polyethylene glycol succinate, epsilon-caprolactone,  
valerolactone, adipic acid esters, citric acid esters,  
glycol-alkyl esters, stearyl esters, phthalates, phenyl  
10 ethers, phenyl esters, and mixtures thereof.

Sub AB 51. The method of Claim 1, wherein said controlled  
manner of hydrolytic degradation is achieved by a process  
of modifying at least one structural characteristic of  
said material, wherein said step of modifying is selected  
5 from the group consisting of modifying the crystallinity  
of said material, modifying the free volume of said  
material, modifying the orientation of said material,  
modifying the molecular weight of said material, modifying  
the surface area of said material, and mixtures thereof.



52. The method of Claim 51, wherein said process of modifying the crystallinity of said material comprises aligning said material in a uniaxial or biaxial orientation.

53. The method of Claim 1, wherein said material has a residual monomer concentration of from about 10 ppm to about 40 weight percent.

54. The method of Claim 1, wherein said controlled manner of hydrolytic degradation is achieved by applying a stress to said material upon disposal of said material, wherein said stress initiates accelerated degradation of  
5 said material.

55. The method of Claim 1, wherein said controlled manner of hydrolytic degradation is achieved by adding at least one hydrophobic compound to said disposable material.

56. The method of Claim 55, wherein said hydrophobic compound has a carbon-to-oxygen ratio of at least about three carbon molecules per oxygen molecule.

57. The method of Claim 55, wherein said hydrophobic compound has a carbon-to-oxygen ratio of at least about six carbon molecules per oxygen molecule.

58. The method of Claim 55, wherein said hydrophobic compound is grafted to the polymeric backbone of said material.

59. The method of Claim 55, wherein said hydrophobic compound is coated onto said material to form a hydrophobic coating.

60. The method of Claim 59, wherein said hydrophobic coating has a contact angle of at least about 90 degrees.

61. The method of Claim 55, wherein said hydrophobic compound comprises a plasticizer.

62. The method of Claim 55, wherein said hydrophobic compound is selected from the group consisting of monomers, polymer blocks, polymers, copolymers, and mixtures thereof.

63. The method of Claim 55, wherein said disposable material further comprises a compatibilizer.

64. The method of Claim 55, wherein said disposable material is coated or laminated with said hydrophobic compound.

65. The method of Claim 55, wherein said hydrophobic compound is selected from the group consisting of hydroxycarboxylic acids having long aliphatic chains, esters having long chain aliphatic acids, esters having long chain oleic acids, esters having long chain alcohols, polyesters, glycerides, ketones, aromatic acids, aromatic ethers, aromatic esters, mineral fillers, and mixtures thereof.

66. The method of Claim 1, wherein said controlled manner of hydrolytic degradation is achieved by adding at least one end-capping agent to said material.

67. The method of Claim 66, wherein said end-capping agent is selected from the group consisting of alcohols, chlorosilanes, alkyl chlorides, acid chlorides, isocyanates, amines, methyl esters, and mixtures thereof.

68. The method of Claim 66, wherein said end-capping agent is reversible.

69. The method of Claim 1, wherein said controlled manner of degradation is achieved by cross-linking said disposable material.

70. The method of Claim 69, wherein said step of cross-linking is accomplished using a cross-linking agent selected from the group consisting of tartaric acid, free-radical generators, multifunctional chain extenders, trifunctional monomers, reactive pendant groups, and mixtures thereof.

71. The method of Claim 69, wherein said disposable material comprises a tartaric acid polymer.

Sub A4 72. The method of Claim 14, wherein said microbial degradation is augmented by adding at least one source of nutrients to said disposable material, wherein said nutrients promote the activity of a microorganism capable of degrading said disposable material.

73. The method of Claim 72, wherein said nutrients are grafted to the polymeric backbone of said material.

74. The method of Claim 72, wherein said nutrients are microencapsulated.

75. The method of Claim 1, wherein said hydroxycarboxylic acid is an  $\alpha$ -hydroxycarboxylic acid.

76. The method of Claim 1, wherein said hydroxycarboxylic acid is selected from the group consisting of lactic acid, glycolic acid, tartaric acid, malic acid, mandelic acid, benzylic acid, hydroxyvaleric acid, 1-

5 hydroxy-1-cyclohexane carboxylic acid, 2-hydroxy-2-(2-tetrahydrofuranyl) ethanoic acid, 2-hydroxy-2-(2-furanyl) ethanoic acid, 2-hydroxy-2-phenylpropionic acid, 2-hydroxy-2-methylpropionic acid, 2-hydroxy-2-methylbutanoic acid, 2-hydroxy-2-ethylhexylcarboxylic acid,  $\alpha$ -hydroxy-

10 butyric acid,  $\alpha$ -hydroxyisobutyric acid,  $\alpha$ -hydroxypentanoic acid,  $\alpha$ -hydroxyhexanoic acid,  $\alpha$ -hydroxyheptanoic acid,  $\alpha$ -hydroxyoctanoic acid,  $\alpha$ -hydroxynonanoic acid,  $\alpha$ -hydroxydecanoic acid,  $\alpha$ -hydroxydodecanoic acid,  $\alpha$ -hydroxymyristic acid,  $\alpha$ -hydroxypalmitic acid,  $\alpha$ -hydroxystearic

15 acid,  $\alpha$ -hydroxyarachidic acid,  $\alpha$ -hydroxybehenic acid,  $\alpha$ -hydroxylignoceric acid,  $\alpha$ -hydroxy-cerotic acid,  $\alpha$ -hydroxyoleic acid,  $\alpha$ -hydroxylinoleic acid,  $\alpha$ -hydroxylinolenic acid,  $\alpha$ -hydroxyarachidonic acid,  $\alpha$ -hydroxypelargonic,  $\alpha$ -hydroxyundecanoic acid,  $\alpha$ -hydroxy-

20 tridecanoic acid,  $\alpha$ -hydroxypentadecanoic acid,  $\alpha$ -hydroxyheptadecanoic acid,  $\alpha$ -hydroxynonadecanoic acid, and mixtures thereof.

77. The method of Claim 1, wherein said hydroxycarboxylic acid is selected from the group consisting of lactic acid, glycolic acid, tartaric acid, malic acid, mandelic acid, benzylic acid, hydroxyvaleric acid,  $\alpha$ -

5 hydroxybutyric acid,  $\alpha$ -hydroxyoctanoic acid,  $\alpha$ -hydroxystearic acid, and mixtures thereof.

78. The method of Claim 1, wherein said hydroxycarboxylic acid is selected from the group consisting of lactic acid, glycolic acid, and mixtures thereof.

| 1. 姓名 |     | 2. 性别 |    | 3. 年龄 |      | 4. 民族 |    | 5. 籍贯 |    | 6. 职业 |    | 7. 文化程度 |    | 8. 政治面貌 |    | 9. 婚姻状况 |    | 10. 健康状况 |     | 11. 兴趣爱好 |    | 12. 特长 |    | 13. 其他 |    |
|-------|-----|-------|----|-------|------|-------|----|-------|----|-------|----|---------|----|---------|----|---------|----|----------|-----|----------|----|--------|----|--------|----|
| 1     | 张三  | 男     | 25 | 汉族    | 湖南长沙 | 教师    | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |
| 2     | 李四  | 女     | 30 | 汉族    | 湖北武汉 | 医生    | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |
| 3     | 王五  | 男     | 28 | 汉族    | 广东广州 | 工程师   | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |
| 4     | 赵六  | 女     | 35 | 汉族    | 四川成都 | 公务员   | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |
| 5     | 孙七  | 男     | 40 | 汉族    | 浙江杭州 | 企业家   | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |
| 6     | 周八  | 女     | 45 | 汉族    | 江苏南京 | 教授    | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |
| 7     | 吴九  | 男     | 50 | 汉族    | 山东济南 | 退休    | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |
| 8     | 郑十  | 女     | 55 | 汉族    | 河南郑州 | 退休    | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |
| 9     | 冯十一 | 男     | 60 | 汉族    | 广西桂林 | 退休    | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |
| 10    | 陈十二 | 女     | 65 | 汉族    | 福建厦门 | 退休    | 大学 | 党员    | 已婚 | 良好    | 阅读 | 写作      | 音乐 | 绘画      | 游泳 | 篮球      | 足球 | 羽毛球      | 乒乓球 | 象棋       | 围棋 | 国际象棋   | 桥牌 | 扑克     | 麻将 |

81. The method of Claim 1, further comprising an indicator that detects degradation.

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82. A method for producing an environmentally degradable disposable material comprising:

- (I) providing a material comprising a hydroxycarboxylic acid-containing polymer capable of hydrolytic degradation during operative and disposal stages in a controlled manner such that the disposal degradation rate of said material is accelerated relative to the operative degradation rate of said material; and
- (II) selecting at least one step from the group consisting of:
- (a) adding at least one activator compound to said material;
  - (b) adding at least one blotting compound to said material;
  - (c) coating said material with at least one coating compound;
  - (d) producing a material comprising a copolymer;
  - (e) adding at least one plasticizer to said material;
  - (f) modifying the crystallinity of said material;
  - (g) modifying the free volume of said material;
  - (h) modifying the orientation of said material;
  - (i) modifying the molecular weight of said material;
  - (j) modifying the surface area of said material;

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cont.

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- (k) applying a stress to said material;
- (l) adding at least one hydrophobic compound to said material;
- (m) adding at least one end-capping agent to said material; and
- (n) cross-linking said material.

83. The method of Claim 82, wherein said material is further capable of being degraded by biological degradation.

84. The method of Claim 82, wherein said material is further capable of being degraded by microbial degradation.

85. The method of Claim 84, wherein said microbial degradation is augmented by adding at least one source of nutrients to said material.

86. The method of Claim 82, wherein said hydroxycarboxylic acid is an  $\alpha$ -hydroxycarboxylic acid.

87. The method of Claim 82, wherein said hydroxycarboxylic acid is selected from the group consisting of lactic acid, glycolic acid, tartaric acid, malic acid, mandelic acid, benzylic acid, hydroxyvaleric acid, 1-hydroxy-1-cyclohexane carboxylic acid, 2-hydroxy-2-(2-tetrahydrofuranyl) ethanoic acid, 2-hydroxy-2-(2-furanyl) ethanoic acid, 2-hydroxy-2-phenylpropionic acid, 2-hydroxy-2-methylpropionic acid, 2-hydroxy-2-methylbutanoic acid, 2-hydroxy-2-ethylhexylcarboxylic acid,  $\alpha$ -hydroxybutyric acid,  $\alpha$ -hydroxyisobutyric acid,  $\alpha$ -hydroxypentanoic acid,  $\alpha$ -hydroxyhexanoic acid,  $\alpha$ -hydroxyheptanoic

acid,  $\alpha$ -hydroxy-octanoic acid,  $\alpha$ -hydroxynonanoic acid,  $\alpha$ -hydroxydecanoic acid,  $\alpha$ -hydroxydodecanoic acid,  $\alpha$ -hydroxymyristic acid,  $\alpha$ -hydroxypalmitic acid,  $\alpha$ -hydroxystearic acid,  $\alpha$ -hydroxyarachidic acid,  $\alpha$ -hydroxybehenic acid,  $\alpha$ -hydroxylignoceric acid,  $\alpha$ -hydroxycerotic acid,  $\alpha$ -hydroxyoleic acid,  $\alpha$ -hydroxylinoleic acid,  $\alpha$ -hydroxylinolenic acid,  $\alpha$ -hydroxyarachidonic acid,  $\alpha$ -hydroxypelargonic,  $\alpha$ -hydroxyundecanoic acid,  $\alpha$ -hydroxytridecanoic acid,  $\alpha$ -hydroxypentadecanoic acid,  $\alpha$ -hydroxyheptadecanoic acid,  $\alpha$ -hydroxynonadecanoic acid, and mixtures thereof.

88. The method of Claim 82, wherein said hydroxy-carboxylic acid is selected from the group consisting of lactic acid, glycolic acid, tartaric acid, malic acid, mandelic acid, benzylic acid, hydroxyvaleric acid,  $\alpha$ -hydroxybutyric acid,  $\alpha$ -hydroxyoctanoic acid,  $\alpha$ -hydroxystearic acid, and mixtures thereof.

89. The method of Claim 82, wherein said hydroxy-carboxylic acid is selected from the group consisting of lactic acid, glycolic acid, and mixtures thereof.

90. The method of Claim 82, wherein said disposable material is selected from the group consisting of lactones, aliphatic esters of glycols, aliphatic esters of dicarboxylic acids; and mixtures thereof.



91. The method of Claim 82, wherein said disposable material comprises a polymer selected from the group consisting of polylactic acids, polylactides, polyglycolic acids, polyglycolides, substituted polyglycolic acids, substituted polyglycolides, caprolactone polymers, valerolactone polymers, and copolymers thereof.

92. The method of Claim 82, wherein said disposable material is selected from the group consisting of films, foams, coatings, molded articles, extruded articles, nonwoven fibers, pellets, powders, laminates, and adhesives.

93. The method of Claim 82, wherein said disposable material is selected from the group consisting of films, foams, coatings, and molded articles.

94. The method of Claim 82, wherein said disposable material comprises a packaging material.

95. The method of Claim 82, wherein said degradation rates comprise changes in the molecular weight of said disposable material over time.

96. The method of Claim 95, wherein said operative degradation rate is less than about 50 percent of said disposal degradation rate.

97. The method of Claim 95, wherein said operative degradation rate is less than about 33 percent of said disposal degradation rate.

98. The method of Claim 95, wherein said operative degradation rate is less than about 10 percent of said disposal degradation rate.

99. The method of Claim 95, wherein said operative degradation rate is less than about 5 percent of said disposal degradation rate.

100. The method of Claim 82, wherein said disposable material is capable of being about 100 percent hydrolytically degraded after discard.

101. The method of Claim 82, wherein said disposable material is at least about 98 percent hydrolytically degraded within about ten years after discard.

102. The method of Claim 82, wherein said disposable material is at least about 98 percent hydrolytically degraded within about five years after discard.

103. The method of Claim 82, wherein said disposable material is at least about 98 percent hydrolytically degraded within about three years after discard.

SubAG → 104. The method of Claim 82, wherein said disposable material is further capable of being biologically degraded to essentially carbon dioxide and water.

105. The method of Claim 82, wherein said disposable material is further capable of being

biologically degraded to essentially carbon dioxide  
and methane.

106. An environmentally degradable disposable material comprising a hydroxycarboxylic acid-containing polymer, wherein said material degrades hydrolytically during operative and disposal stages in a controlled manner such that the disposal degradation rate of said material is accelerated relative to the operative degradation rate of said material.

107. The disposable material of Claim 106, wherein said hydroxycarboxylic acid is an  $\alpha$ -hydroxycarboxylic acid.

108. The disposal material of Claim 106, wherein said hydroxycarboxylic acid is selected from the group consisting of lactic acid, glycolic acid, tartaric acid, malic acid, mandelic acid, benzylic acid, hydroxyvaleric acid, 1-hydroxy-1-cyclohexane carboxylic acid, 2-hydroxy-2-(2-tetrahydrofuranyl) ethanoic acid, 2-hydroxy-2-(2-furanyl) ethanoic acid, 2-hydroxy-2-phenylpropionic acid, 2-hydroxy-2-methylpropionic acid, 2-hydroxy-2-methylbutanoic acid, 2-hydroxy-2-ethylhexylcarboxylic acid,  $\alpha$ -hydroxybutyric acid,  $\alpha$ -hydroxyisobutyric acid,  $\alpha$ -hydroxypentanoic acid,  $\alpha$ -hydroxyhexanoic acid,  $\alpha$ -hydroxyheptanoic acid,  $\alpha$ -hydroxyoctanoic acid,  $\alpha$ -hydroxynonanoic acid,  $\alpha$ -hydroxydecanoic acid,  $\alpha$ -hydroxydodecanoic acid,  $\alpha$ -hydroxymyristic acid,  $\alpha$ -hydroxypalmitic acid,  $\alpha$ -hydroxystearic acid,  $\alpha$ -hydroxyarachidic acid,  $\alpha$ -hydroxybehenic acid,  $\alpha$ -hydroxylig-

noceric acid,  $\alpha$ -hydroxycerotic acid,  $\alpha$ -hydroxyoleic acid,  $\alpha$ -hydroxylinoleic acid,  $\alpha$ -hydroxylinolenic acid,  $\alpha$ -hydroxyarachidonic acid,  $\alpha$ -hydroxypelargonic, 20  $\alpha$ -hydroxyundecanoic acid,  $\alpha$ -hydroxytridecanoic acid,  $\alpha$ -hydroxypentadecanoic acid,  $\alpha$ -hydroxyheptadecanoic acid,  $\alpha$ -hydroxynonadecanoic acid, and mixtures thereof.

109. The disposable material of Claim 106, wherein said hydroxycarboxylic acid is selected from the group consisting of lactic acid, glycolic acid, tartaric acid, malic acid, mandelic acid, benzylic 5 acid, hydroxyvaleric acid,  $\alpha$ -hydroxybutyric acid,  $\alpha$ -hydroxyoctanoic acid,  $\alpha$ -hydroxystearic acid, and mixtures thereof.

110. The disposable material of Claim 106, wherein said hydroxy-carboxylic acid is selected from the group consisting of lactic acid, glycolic acid, and mixtures thereof.

111. The disposable material of Claim 106, wherein said disposable material is selected from the group consisting of lactones, aliphatic esters of glycols, aliphatic esters of dicarboxylic acids; and 5 mixtures thereof.

112. The disposable material of Claim 106, wherein said disposable material comprises a polymer selected from the group consisting of polylactic acids, polylactides, polyglycolic acids, polygly- 5 colides, substituted polyglycolic acids, substituted

polyglycolides, caprolactone polymers, valerolactone polymers, and copolymers thereof.

113. The disposable material of Claim 106, wherein said disposable material is selected from the group consisting of films, foams, coatings, molded articles, extruded articles, nonwoven fibers, pellets, powders, laminates, and adhesives.

114. The disposable material of Claim 106, wherein said disposable material is selected from the group consisting of films, foams, coatings, and molded articles.

115. The disposable material of Claim 106, wherein said disposable material comprises a packaging material.

116. The disposal material of Claim 106, wherein said degradation rates comprise changes in the molecular weight of said disposable material over time.

117. The disposable material of Claim 116, wherein said operative degradation rate is less than about 50 percent of said disposal degradation rate.

118. The disposable material of Claim 116, wherein said operative degradation rate is less than about 33 percent of said disposal degradation rate.

119. The disposable material of Claim 116, wherein said operative degradation rate is less than about 10 percent of said disposal degradation rate.

120. The disposable material of Claim 116, wherein said operative degradation rate is less than about 5 percent of said disposal degradation rate.

121. The disposable material of Claim 106, wherein said material is capable of being about 100 percent hydrolytically degraded after discard.

122. The disposable material of Claim 106, wherein said material is at least about 98 percent hydrolytically degraded within about ten years after discard.

123. The disposable material of Claim 106, wherein said material is at least about 98 percent hydrolytically degraded within about five years after discard.

124. The disposable material of Claim 106, wherein said material is at least about 98 percent hydrolytically degraded within about three years after discard.

125. The disposable material of Claim 106, wherein said disposable material is further capable of being degraded by biological degradation.

126. The disposable material of Claim 106, wherein said disposable material is further capable of being degraded by microbial degradation.

127. The disposable material of Claim 106, wherein said disposable material is further capable of being biologically degraded to essentially carbon dioxide and water.

[illegible]



Sub A7

129. An environmentally degradable disposable material comprising a hydroxycarboxylic acid-containing polymer, wherein said material degrades hydrolytically during operative and disposal stages in a controlled manner such that the disposal degradation rate of said material is accelerated relative to the operative degradation rate of said material and wherein said material is produced by a method comprising at least one step selected from the group consisting of:
- (a) adding at least one activator compound to said material;
  - (b) adding at least one blotting compound to said material;
  - (c) coating said material with at least one coating compound;
  - (d) producing a material comprising a copolymer;
  - (e) adding at least one plasticizer to said material;
  - (f) modifying the crystallinity of said material;
  - (g) modifying the free volume of said material;
  - (h) modifying the orientation of said material;
  - (i) modifying the molecular weight of said material;
  - (j) modifying the surface area of said material;
  - (k) applying a stress to said material;

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cont.

(l) adding at least one hydrophobic compound to said material;

30 (m) adding at least one end-capping agent to said material; and

(n) cross-linking said material.

130. The disposable material of Claim 129, wherein said material is further capable of being degraded by biological degradation.

131. The disposable material of Claim 129, wherein said material is further capable of being degraded by microbial degradation.

132. The disposable material of Claim 131, wherein said microbial degradation is augmented by adding at least one source of nutrients to said material.

133. The disposable material of Claim 129, wherein said hydroxycarboxylic acid is an  $\alpha$ -hydroxycarboxylic acid.

134. The disposable material of Claim 129, wherein said hydroxy-carboxylic acid is selected from the group consisting of lactic acid, glycolic acid, tartaric acid, malic acid, mandelic acid, benzylic acid, hydroxyvaleric acid, 1-hydroxy-1-cyclohexane  
5 carboxylic acid, 2-hydroxy-2-(2-tetrahydrofuranyl) ethanoic acid, 2-hydroxy-2-(2-furanyl) ethanoic acid, 2-hydroxy-2-phenylpropionic acid, 2-hydroxy-2-methylpropionic acid, 2-hydroxy-2-methylbutanoic acid, 2-  
10 hydroxy-2-ethylhexylcarboxylic acid,  $\alpha$ -hydroxy-

butyric acid,  $\alpha$ -hydroxyisobutyric acid,  $\alpha$ -hydroxy-  
pentanoic acid,  $\alpha$ -hydroxyhexanoic acid,  $\alpha$ -hydroxy-  
heptanoic acid,  $\alpha$ -hydroxyoctanoic acid,  $\alpha$ -hydroxynon-  
anoic acid,  $\alpha$ -hydroxydecanoic acid,  $\alpha$ -hydroxy-  
15 dodecanoic acid,  $\alpha$ -hydroxymyristic acid,  $\alpha$ -hydroxy-  
palmitic acid,  $\alpha$ -hydroxystearic acid,  $\alpha$ -hydroxy-  
arachidic acid,  $\alpha$ -hydroxybehenic acid,  $\alpha$ -hydroxy-  
lignoceric acid,  $\alpha$ -hydroxycerotic acid,  $\alpha$ -hydroxy-  
oleic acid,  $\alpha$ -hydroxylinoleic acid,  $\alpha$ -hydroxylin-  
20 olenic acid,  $\alpha$ -hydroxyarachidonic acid,  $\alpha$ -hydroxy-  
pelargonic,  $\alpha$ -hydroxyundecanoic acid,  $\alpha$ -hydroxy-  
tridecanoic acid,  $\alpha$ -hydroxypentadecanoic acid,  $\alpha$ -  
hydroxyheptadecanoic acid,  $\alpha$ -hydroxynonadecanoic  
acid, and mixtures thereof.

135. The disposable material of Claim 129,  
wherein said hydroxycarboxylic acid is selected from  
the group consisting of lactic acid, glycolic acid,  
tartaric acid, malic acid, mandelic acid, benzylic  
5 acid, hydroxyvaleric acid,  $\alpha$ -hydroxybutyric acid,  $\alpha$ -  
hydroxyoctanoic acid,  $\alpha$ -hydroxystearic acid, and  
mixtures thereof.

136. The disposable material of Claim 129,  
wherein said hydroxy-carboxylic acid is selected from  
the group consisting of lactic acid, glycolic acid,  
and mixtures thereof.

137. The disposable material of Claim 129,  
wherein said disposable material is selected from the  
group consisting of lactones, aliphatic esters of

glycols, aliphatic esters of dicarboxylic acids; and  
5 mixtures thereof.

138. The disposable material of Claim 129,  
wherein said disposable material comprises a polymer  
selected from the group consisting of polylactic  
acids, polylactides, polyglycolic acids,  
5 polyglycolides, substituted polyglycolic acids,  
substituted polyglycolides, caprolactone polymers,  
valerolactone polymers, and copolymers thereof.

139. The disposable material of Claim 129,  
wherein said disposable material is selected from the  
group consisting of films, foams, coatings, molded  
articles, extruded articles, nonwoven fibers,  
5 pellets, powders, laminates, and adhesives.

140. The disposable material of Claim 129,  
wherein said disposable material is selected from the  
group consisting of films, foams, coatings, and  
molded articles.

141. The disposable material of Claim 129,  
wherein said disposable material comprises a  
packaging material.

142. The disposal material of Claim 129,  
wherein said degradation rates comprise changes in  
the molecular weight of said disposable material over  
time.

143. The disposable material of Claim 142,  
wherein said operative degradation rate is less than  
about 50 percent of said disposal degradation rate.

144. The disposable material of Claim 142, wherein said operative degradation rate is less than about 33 percent of said disposal degradation rate.

145. The disposable material of Claim 142, wherein said operative degradation rate is less than about 10 percent of said disposal degradation rate.

146. The disposable material of Claim 142, wherein said operative degradation rate is less than about 5 percent of said disposal degradation rate.

147. The disposable material of Claim 129, wherein said material is capable of being about 100 percent hydrolytically degraded after discard.

148. The disposable material of Claim 129, wherein said material is at least about 98 percent hydrolytically degraded within about ten years after discard.

149. The disposable material of Claim 129, wherein said material is at least about 98 percent hydrolytically degraded within about five years after discard.

150. The disposable material of Claim 129, wherein said material is at least about 98 percent hydrolytically degraded within about three years after discard.

Sub AB → 151. The disposable material of Claim 129, wherein said disposable material is further capable of being biologically degraded to essentially carbon dioxide and water.

152. The disposable material of Claim 129, wherein said disposable material is further capable of being biologically degraded to essentially carbon dioxide and methane.

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153. An environmentally degradable disposable material comprising a hydroxycarboxylic acid-containing polymer, wherein said hydroxycarboxylic acid is selected from the group  
5 consisting of lactic acid, L-lactide, D-lactide, D,L-lactide, and mixtures thereof, and wherein said material degrades hydrolytically during operative and disposal stages in a controlled manner such that the disposal degradation rate of said material is  
10 accelerated relative to the operative degradation rate of said material.

154. A disposable material of Claim 153, wherein said material is a packaging material.

155. The disposal material of Claim 153, wherein said degradation rates comprise changes in the molecular weight of said disposable material over time.

156. The disposable material of Claim 155, wherein said operative degradation rate is less than about 33 percent of said disposal degradation rate.

157. The disposable material of Claim 155, wherein said operative degradation rate is less than about 5 percent of said disposal degradation rate.

158. The disposable material of Claim 153, wherein said material is capable of being about 100 percent hydrolytically degraded after discard.

159. The disposable material of Claim 153, wherein said material is at least about 98 percent

hydrolytically degraded within about five years after discard.

160. A disposable material of Claim 153, wherein said material further comprises at least one microencapsulated activator compound.

161. A disposable material of Claim 160, wherein said activator compound is selected from the group consisting of an acidic compound and a moisture-containing compound and wherein said  
5 disposable material is coated or laminated with said microencapsulated activator compound.

162. A disposable material of Claim 153, wherein said material further comprises at least one blotting compound.

163. A disposable material of Claim 162, wherein said blotting compound is a water grabber.

164. A disposable material of Claim 153, wherein said material further comprises an abrasion-prone, hydrophobic coating.

165. A disposable material of Claim 164, wherein said abrasion-prone, hydrophobic coating has a contact angle of at least about 90 degrees.

166. A disposable material of Claim 164, wherein said material further comprises a coating comprising at least one blotting compound positioned underneath said abrasion-prone, hydrophobic coating.



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